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DOI: https://doi.org/10.1163/9789004459694_007

Chapter 5: The Institution of the Jalālī Calendar in 1079 C.E. and its cohabitation with the old Persian calendar

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1. Introduction

One of the universal problems in the history of calendars is the relationship between the description of a particular calendrical system in literary texts and its presence in documentary sources. In general, the first kind of source provides information on its technical details and its historical contexts, while the second kind of source allows us to draw conclusions on its use in everyday life, which in German is called 'Sitz im Leben'. Highly specialized studies may well concentrate on one of the two kinds of sources, but general accounts should always have an eye on both sides. In the present article an exercise in this double view will be presented, and hopefully it will be shown how misleading it can be if one of the two sides is neglected. The case represents an example of opposing characteristics in literary and documentary traditions.

The calendrical system in question is a modernized version of the Persian calendar, introduced during the reign of the Seljuq Sultan Malikshāh (1072–1092 CE).[1] The calendar is named after his honorific title Jalāl al-Dawla, therefore 'Jalālī'. Alternatively, the terms *malikshāhī* and *malikī* were also used.

Malikshāh was the son of Alp Arslān, who defeated the Byzantine army at Manzikert in 1071 CE. In the following years, Malikshāh conquered almost the entirety of Anatolia, and for the first time in history, this territory became populated by Turks.[2]

One of the first accounts of Malikshāh's calendrical reform mentions his famous vizier Niẓām al-Mulk as its leading initiator. Niẓām al-Mulk is well known as the author of the *Siyāsatnāma*, a Persian book on political governance. The secular character of the book has branded its author as the Islamic Machiavelli.[3]

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1 F.C. de Blois, 'Taʾrīkh: I. Dates and Eras in the Islamic World: 1. In the sense of "date, dating", etc.', in: P.J. Bearman et al. *Encyclopaedia of Islam: New Edition*, vol. X (Leiden: Brill, 2000), pp. 258–64, esp. 262; F.K. Ginzel, *Handbuch der mathematischen und technischen Chronologie: Das Zeitrechnungswesen der Völker* (Leipzig: J.C. Hinrichs, 1906–1914), vol. I pp. 300–305; S.H. Barani, 'The Jalali calendar (tarikh-i-Jalali or Maliki)', *Islamic Culture* 17 (1943), pp. 166-175; R. Abdullāhī, *Tārīkh-i tārīkh dar Īran* (Tehran: Intishārāt-i Amīr Kabīr, 1987), pp. 279–299.

2 S. Vryonis, *The Decline of Medieval Hellenism in Asia Minor and the Process of islamization from the Eleventh through the Fifteenth Century* (Publications of the Center for Middle Eastern Studies 4; Berkeley: California University Press, 1971); A.D. Beihammer, *Byzantium and the Emergence of Muslim-Turkish Anatolia, ca. 1040-1130* (Birmingham Byzantine and Ottoman studies 20; London: Routledge, 2017).

3 J.W. Meri (ed.), *Medieval Islamic Civilization: An Encyclopedia* (London: Routledge, 2005).

2. The Persian calendar in Achaemenid, Sasanian and early Islamic times[4]

Originally, the Persian calendar was a Babylonian type lunisolar calendar, the so-called Old Persian calendar. In 525 BCE, Egypt was conquered and became a province of the Achaemenid Empire. Sometime later, probably between 481 BCE and 479 BCE, the Egyptian calendar was adapted by the emperor for the organization of the Zoroastrian cult; we might call it the Egypto-Zoroastrian calendar, or the Persian-Zoroastrian calendar. The Achaemenid rulers were proud of Egypt, their richest province, and therefore they might have chosen it for establishing uniformity of calendrical practice in the northern and eastern satrapies.[5] For non-religious purposes the Old Persian calendar remained in use: in a document written in 11 February 356 BCE, the dates are in the Old Persian calendar as well as in the Persian-Zoroastrian calendar.[6]

The Egyptian and Persian-Zoroastrian year consists of twelve months of 30 days and five additional days at the end of the year, the so-called epagomenal days. With its 365 days, the calendrical year is a quarter of a day shorter than the tropical solar year; every four years, its beginning falls one day behind in the seasons. Nevertheless, this calendar remained unchanged in Persia until the end of the 5th century CE.

At the beginning of the 6th century, a reform of the calendar was implemented in the Sasanian Empire. Two changes were made: the New Year was transferred from the beginning of the first month to the beginning of the ninth; and consequently, the epagomenal days were transferred from after the end of the twelfth month to after the end of the eighth. This shift of the epagomenal days led to a loss of five days and caused an earlier start of the year by five days. In the history of the Persian calendar from its beginning until early Islamic times, this was the only reform that really happened; all alleged reports of intercalated months are only legend.[7]

After the end of the Sasanian Empire in 651 CE, the years were counted according to an era based on the regnal years of the last Emperor Yazdgird III, with the epoch of 16 June 632 CE.

After 1007 CE, the five epagomenal days were shifted back from after the eighth month (Ābān) to the end of the year.

The months are all 30-days long, and their names are:

1. Farwardīn
2. Urdībihisht
3. Khurdādh
4. Tīr
5. Murdādh
6. Shahrīwar
7. Mihr
8. Ābān

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4 This section is based on F.C. de Blois, 'The Persian Calendar', *Iran* 34 (1996), pp. 39–54 and S. Stern, *Calendars in Antiquity: Empires, States, and Societies* (Oxford: Oxford University Press, 2012), pp. 169–91.

5 Stern, *Calendars in Antiquity*, p. 190.

6 F.C. Blois, 'The Zoroastrian Calendar: New Evidence from Achaemenid Bactria', in : N. Sims-Williams and F.C. de Blois (eds), *Studies in the Chronology of the Bactrian Documents from Northern Afghanistan* (Wien: Verlag der Österreichischen Akademie der Wissenschaften, 2018), pp. 109–12, esp. 111.

7 De Blois, 'Persian Calendar', p. 50.

9. Adhar
10.Day
11. Bahman
12. Isfandārmudh

3. Attempts to reform the Persian calendar before the Jalalī reform

The oldest source on Malikshāh's calendar reform is the *Nawrūznāma*, attributed to ʿUmar Khayyām, but most probably not written by him.[8] In a section on various attempts to reform the Persian calendar, he reports the inconvenience of the beginning of the year having shifted from summer to spring, due to the Persian calendar having a fixed year of 365 days: the people had to pay their taxes earlier in the year, when the crop was still short. The Abbasid caliph al-Mutawakkil (r. 847–861) tried to reform the calendar, since in his time, the beginning of the year had shifted to April.[9] His reform did not last. In later documents, Persian dates are still based on the era of Yazdgird beginning from 16 June 632 CE.

The *Nawrūznāma* reports a second attempt to reform the calendar by Khalaf ibn Aḥmad, the Saffarid Amīr of Sīstān (r. 963–1009 CE).[10] In his time, Nawrūz had shifted from June to March. But recorded dates show that the Era of Yazdgird was still used. This is evident from inscriptions.

A particular case is the Arabic inscription on the Waruh Gorge, which has three dates: a complete Hijra date, and the corresponding months of the Persian and Syrian calendars. The Hijra date is fixed by the day of the week and corresponds to 19 December 1041 CE, in the Syrian calendar the month Kanūn I. In the Persian calendar based on the Yazdgird era, this corresponds to day 29 of the Persian month *Day* if the five epagomenal days came after the month Isfandarmudh, and to day 24 of the same month if they came after Ābān. At the beginning of the 11th century CE, the epagomenal days were shifted back to their original pace after the twelfth month (Isfandarmudh), but it remains to be investigated when this was implemented in practice in the different regions of the Eastern Islamic world. But if a reformed calendar as indicated in the *Nawrūznāma* had been used, another month would have been written in this inscription.

However, the reform was not entirely forgotten. Nāṣir-i Khusraw (1004–1060 CE) wrote a travel book on his Journey. He lived in Marw, and after a dream vision, he asked for leave from his administrative duties and travelled to the West, to Iran, Iraq, Syria, Egypt and the Arab Peninsula. What concerns us here is that in four cases he supplemented the usual Hijra date with the corresponding Persian month and the day in that month:[11]

1. [Tuesday] 20 Ṣafar 438 AH = 25 Shahrīwar [415 AY] [= 26 August 1046 CE]

2. Sunday 6 Ṣafar 439 AH = Urmuzd [1] Shahrīwar [416 AY] [= 2 August 1047 CE]

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8 F.C. Blois, *Persian Literature: A Bio-bibliographical Survey: Volume V, Part 2: Poetry ca. A.D. 1100 to 1225* (Leiden: Brill, 1994), p. 359.

9 [ps.–]ʿUmar Khayyām, *Nawrūznāma* (ed. by Mojtaba Minovi; Tehran: Kaveh, 1933), p. 12; De Blois, 'The Persian Calendar', pp. 45–46.

10 [ps.-]ʿUmar al-Khayyām, *Nawrūznāma*, p. 12.

11 Nāṣir Ḫusrau, *Book of travels = Safarnāmah: a parallel Persian-English text* (ed. and transl. W.M. Thackston; Bibliotheca Iranica. Intellectual traditions series 6; Costa Mesa, Calif.: Mazda Publishers, 2001), pp. 6, 51, 92, and 105.

3. 1 Rajab – 20 Dhū l-Ḥijja 442 AH [= 19 Nov. 1050 – 5 May 1051 CE] ~ 15 Farwardīn [420 AY] [= 18 March 1051 CE]

4. Friday 19 Dhū l-Ḥijja 442 AH = 1 Khurdādh [420 CE] [= 3 May 1051 CE]

Cases 1, 2 and 4 show an accurate match of the dates in the two calendars, provided the era of Yazdgird is used; Nāṣir-i Khusraw thus still used the traditional Persian calendar (case 3 is inconclusive). However, he must have been aware of the existence of a reformed calendar. In all cases, he has added the word *qadīm* ('old'): *Shahriwar māh-i qadīm, Farwardīn-i qadīm, Khurdād mah-i qadīm.* We can only guess which new calendar these dates were meant to be distinguished from. Marw, the home of Nāṣir-i Khusraw, was under Ghaznavid rule.

There was indeed a calendar reform during the rule of Masʿūd the son of Maḥmūd of Ghazna (r. 1030–1040 CE).[12] It was praised in panegyrical poems. The main point appears to have been the readjustment of two holidays: *sāda*, the 'feast of the return of the light', and *nawrūz*, the celebration of New Year. Both were celebrated with traditional rituals, and in their symbolism, they were connected to the noticeable increase of day length in January and to the spring equinox in March. The reform seems to have had the purpose of putting the two holidays back to their appropriate place in the tropical year. It might have been restricted to the calendar of Persian festivals, and had no significance for other areas of life.

4. The reform of Malikshāh

The next reform reported in the *Nawrūznāma* was the one by the Seljuq ruler Malikshāh. He had been told about the inconvenience of the early Nawrūz, and decided to fix the beginning of the year at the spring equinox. For this purpose, he commissioned the best astronomers of the time from Khurasan. They built an observatory and began with observation. But according to the report in the *Nawrūznāma*, the task was not completed: as is explicitly stated, the intercalation did not take place. The text is somewhat unclear when it comes to determining the reason. Either Malikshāh lost patience and stopped the project, or he died and his successor was no longer interested.[13] If this report can be trusted, one may ask how the era that bears his name came into being.

The first historian who gave an account of this reform was Ibn al-Athīr (1160–1233 CE). He separates the reform of the calendar from the construction of an observatory and the astronomical observations. According to him, the observations ceased after Malikshāh's death and the observatory was demolished.[14] In the context of the calendar reform, in which *nawrūz* was set to the spring equinox, he mentions an anonymous group of astronomers. But in the context of the astronomical observations, he reports the names of three astronomers: the famous ʿUmar Khayyām, the well-known Abū l-Muẓaffar al-Isfizārī, and the unknown Maymūn ibn al-Najīb al-Wāsiṭī. ʿUmar Khayyām may well have joined the group of astronomers at a later time, or he might have been involved in the observations only and not in the calendar reform. From Ḥajjī Khalīfa's Lexicon we know that ʿUmar Khayyām produced astronomical tables dedicated to Malikshāh, the *Zīj-i*

12 S. Cristoforetti, *Il natale della luce in Iran: Une festa delfuoco nel cuore di ogni inverno: Ricerche sul* sada*: occorrenze rituale e temi mitologici di una celebrazione cortese tra Baghdad e Bukhara, secc. IX–XII* (Milano: Associazione Culturale Mimesis, 2002), p. 167.

13 [ps.-]ʿUmar al-Khayyām, *Nawrūznāma*, p. 89; .

14 Ibid., p. 89; on the observations there in general see: B.A. Rozenfeld and A.P. Juškevič, *Omar Chajjam* (Moscow: Izd. Nauka, 1965), pp. 66–76.

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Malikshāhī, which is generally believed to be lost.[15] However, the Union Catalogue of Manuscripts in Iran refers to a copy of a *Zīj Malikshāhī* (Tehran, Millī 26211).[16] These tables might have been based on the observations at the court of Malikshāh in Isfahan.

Al-Khāzinī (active ca. 1120–1130 CE), a younger contemporary of ʿUmar Khayyām, prepared astronomical tables for Malikshāh's son Sanjar, *al-Zīj al-Sanjarī*. In the section on the different eras in history, he reports on Malikshāh's reform.[17] According to him, the Sultan ordered first to determine the vernal equinox, and after that the times when the sun enters the next zodiacal sign.

Two different dates of the new era are found in the sources. In the *Zīj* of Ulugh Beg (d. 1449 CE), the problem of these two different eras is briefly discussed; the dates are Sunday, 5 Shaʿbān 468 AH (13 March 1076), and Friday, 10 Ramaḍān 471 AH (15 March 1079); the later one is declared as the preferred.[18] The earlier date seems to have been the original one; at some time it was replaced by the later date.[19] Furthermore, an intercalation scheme was introduced. It was based on the Julian intercalation scheme, but every 25 years, another intercalary day was added. Both the epoch and the intercalation are erroneous. The true equinox was on 15 March at that epoch, and the correction of the Julian intercalation scheme is in the wrong direction. Instead of increasing the intercalary days, they should have been reduced. Other accounts report exactly such a correct improvement of the Julian intercalation scheme.[20]

Al-Khāzinī's account is the first technical description of the Jalālī calendar. The beginning of its epoch is set to Sunday, 13 March 1076, three years earlier than in later reports. In the text, a table and a description follow on how to convert dates of the Jalālī calendar.

The Jalālī calendar is used in the *Dustūr al-munajjimīn*, but no chronological parts of the work have been preserved.[21]

In later astronomical tables, the Jalālī calendar is regularly dealt with. Naṣīr al-Dīn al-Ṭūsī (1201–1274 CE) devoted a longer chapter to it in his *Zīj-i Īlkhānī* for the Mongol emperor Hülägū in 1272 CE.[22] The great success of these tables might have reinforced the inclusion of the Jalālī calendar as a topic in the chronological parts of astronomical tables produced in the Eastern parts of the Islamic World, and later in the Ottoman Empire.

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15 Ḥajjī Khalīfa, *Kash al-ẓunūn ʿan asāmī l-kutub wa-l-funūn = Keşf-el-zunun* (ed. Ş. Yaltkaya and R. Bilge; İstanbul: Milli Eğitim Basımevi, 1971), vol. 2, 966.

16 M. Dirāyatī, *Fihristgān: nuskha-hā-yi khaṭṭī-i Īrān (Fankhā)*, Nuskhah'shināsī 1 (Tehran: Sāzmān-i Asnād wa Kitābkhāna-i Millī-i Jumhūrī-i Islāmī-i Īrān, 2011), vol. 17, p. 809.

17 J.G. Leichter, *The Zīj as-Sanjarī of Gregory Chioniades: Text, Translation and Greek to Arabic Glossary* (Ph.D. thesis, Brown University, 2004), p. 29.

18 L.P.E. Sédillot, *Prolégomènes des tables astronomiques d'Oloug-Beg, publiés avec notes et variantes et précédés d'une introduction* (Peris: Firmin Didot, 1847), pp. 25–26 (Persian text) and 27 (translation).

19 H.R. Giahi Yazdi, 'The *Jalālī* Celendar: The Enigma of its Radix Date', *Archive for History of Exact Sciences* 74 (2020), pp. 165–82, esp. 180.

20 See text and translation in Appendix I.2.

21 B. van Dalen, 'The Malikī Calendar in the *Dustūr al-munajjimīn*', in E. Orthmann and P. Schmidl (eds), *Science in the City of Fortune: The* Dustūr al-Munajjimīn *and its World* (Bonner Islamstudien 39; Berlin: EB-Verlag, 2017), pp. 117–35.

22 See text and translation in Appendix II.2.

The most influential of all later tables were those produced under the direction of Ulugh Beg (1394–1449 CE) in Samarqand.[23]

5. Documentary evidence for the Jalālī calendar

The historical and astronomical sources describe Malikshāh's reform of the Persian calendar as a prominent event and leave the impression that the older Persian calendar was abandoned. But how far can this be supported by documentary evidence?

The first place to direct one's attention to are inscriptions. The only inscription recorded in the *Thesaurus d'Épigraphie Islamique* containing a Jalālī year is found on an astrolabe which used to be part of a private collection in Benares.[24] Its present location is unknown, and no reproduction was published. According to the description of Morley in 1856 CE, years in four calendars were inscribed on both sides of the astrolabe.

Recto: 'year 193 of Malikshāh'

Verso: '640 of Yazdgird, 1582 of Iskandar Rūmī'

'Maḥmūd ibn ʿAlī ibn Yūsha … year 669 of the Hijra'

If the standard eras are used, the dates are close together but do not match perfectly. However, the Jalālī era of 1079 is closer to the other dates than the era of 1076 assumed in *al-Zīj al-Sanjarī*. Moreley concluded from the owner's inscription that the astrolabe was made for the chief Vizier of the Mamluk Sultan Baybars. This would be an important clue for the use of the Jalālī era in the Western part of the Islamic world. But the fact that it appears on an astronomical instrument limits this evidence. The astrolabe maker might have converted the Hijra date, which appears together with his signature, into all calendars described in his astronomical tables.

In official monumental inscriptions from the time of Malikshāh, the era named after him does not occur. In the Friday mosque of Isfahan, two domes were built during his reign. The southern dome was founded by Malikshāh's chancellor Niẓām al-Mulk, and the northern dome by his rival Tāj al-Mulk. The inscription in the northern dome has a date: 'in the months of the year four-hundred eighty-one'. This date must be a Hijra date. If it were a Persian year based on the Yazdgird era, this year would be long after the death of Malikshāh. The inscription of the southern dome contains a long praise of Malikshāh and the name of Niẓām al-Mulk, but no date. From evidence provided through the titles mentioned, it can be concluded that the construction must have taken place no earlier than 1086 CE. This was definitely after the calendar reform, but the era was not used for official purposes. The same holds true for later inscriptions.

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23 L.P.E. Sédillot, *Prolégomènes des tables astronomiques d'Oloug-Beg, publiés avec notes et variantes et précédés d'une introduction* (Peris: Firmin Didot, 1847); Uluğ Beg, *Zidž: Novye Guraganovy astronomičeskie tablicy* (transl. A.A. Achmedov Taškent: Fan, 1994); Uluğ Beg, *Uluğ Beg'in astronomi cetvelleri: Zîc-i Uluğ Beg* (Bilimin ve felsefenin doğulu öncüleri dizisi 13; Istanbul: Kültür ve Turizm Bakanlığı, 2012).

24 http://www.epigraphie-islamique.org, accessed 4 November 2017, no. 2263.

Iranian dates with years in the Yazdgird era do appear in some inscriptions. The earliest is on an epitaph in Sri Lanka. [25] Next in time is a foundation inscription for the year 1203 CE.[26] Later inscriptions with years in the era of Yazdgird are restricted to astronomical instruments produced in Iran.[27]

Another place to look at would be numismatic evidence of the use of the Jalālī era. It seems, however, that years in the Jalālī era do not occur in coins.[28] The same seems to be true for official and private documents. Generally, archives in Iran do not contain documents earlier than 1500 CE. A singular exception is the archive of the Ṣafawid order in Ardabil, which was discovered in 1970.[29] The few extant documents of the early Seljuq period are all dated with Hijra years only.[30] The earliest of them, a deed from Khotan, bears the date 501 without further specification, but it is most likely a Hijra year, and certainly not a Jalālī year.[31] In an Arabic court order from Yārkand (Central Asia) the year 503 and the Arabic Month Shaʿbān are mentioned, definitely a Hijra date.[32]

These examples suggest that the Jalālī era was not used for administrative purposes. But then the question arises, why the astronomical tables provide descriptions and conversion tables for converting Jalālī dates at all.

The only documentary (or semi-literary) sources containing such dates are astronomical-astrological documents. The earliest example appears in two fragments in Berlin, found in a book binding.[33] They belonged to two consecutive leaves of a yearbook containing astronomical and astrological information which can be dated astronomically to the year 1182/1183 CE. This type of yearbook was first produced in the 11th century CE.[34] Two fragments containing data for the Persian year 413 AY (= 1044/1045 CE) are the first example of this type.[35] An almost entirely preserved leaf of a yearbook for the Hijra year 544 AH (= 1149/1150 CE) gives a clear picture of the layout of the spread with

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25 For this and the following inscriptions see Appendix I.5.

26 See text and translation in Appendix I.6

27 See texts and translations in Appendix I.7–12; for exclusive use of the hijra in other documents see: G. Herrmann, *Persische Urkunden der Mongolenzeit: Text- und Bildteil* (Documenta Iranica et Islamica 2; Wiesbaden: Harrassowitz, 2004), pp. 24–26; G. Herrmann, 'Urkundenfunde in Āẕerbāyğān', *Archäologische Mitteilungn aus Iran* N.F. 4 (1971), pp. 249–62; M. Gronke, *Derwische im Vorhof der Macht: Sozial- und Wirtschaftsgeschichte Nordwestirans im 13. und 14. Jahrhundert* (Freiburger Islamstudien 15; Stuttgart: Steiner, 1993), pp. 54–55.

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28 Personal information by Lutz Ilisch, Tübingen (e-mail 26 June 2017).

29 G. Herrmann, *Persische Urkunden der Mongolenzeit: Text- und Bildteil* (Documenta Iranica et Islamica 2; Wiesbaden: Harrassowitz, 2004).

30 For a survey of early Persian documents see M. Gronke, *Derwische im Vorhof der Macht: Sozial- und Wirtschaftsgeschichte Nordwestirans im 13. und 14. Jahrhundert* (Freiburger Islamstudien 15; Stuttgart: Steiner, 1993), p. 14.

31 V. F. Minorsky, 'Some early documents in Persian I', *Journal of the Royal Asiatic Society* (1942), pp. 181–194, especially p. 186.

32 M. Gronke, 'The Arabic Yārkand Documents', *Bulletin of the School of Oriental and African Studies* 49 (1986), pp. 454–507, esp. 489; for the use of the hijra calendar in Persian documents see: M..

33 See Appendix I.13.

34 J. Thomann, 'From Katarchai to Ikhtiyārāt: The Emergence of a New Arabic Document Type Combining Ephemerides and Amanacs', in A. Nodar and S. Torallas Tovar (eds), *Proceedings of the 28th Congress of Papyrology Barcelona 1–6 August 2016 (*Barcelona: Publicacions de l'Abadia de Montserrat, 2019), pp. 342-54.

35 Idem, 'Ephemeride für das persische Jahr 413 (1044/1045 n. Chr.)', in A. Zdiarsky (ed.), *Orakelsprüche, Magie und Horoskope: wie Ägypten in die Zukunft sah* (Nilus 22; Wien: Phoibos-Verlag, 2015), pp. 138–40.

information for one month.[36] On the right side, the traditional layout of an ephemeris with the calendarium and the daily positions of sun, moon, and planets is depicted. The calendarium contains the days of the Arabic, Coptic, Syriac and Persian months. The Persian dates are based on the era of Yazdgird, despite the fact that it was created more than half a century after Malikshāh's reform.

In contrast to these examples, which were produced in Egypt, the yearbook of 1182/1183 was made in northern Iraq or Syria, perhaps in Aleppo. For this reason, the Coptic calendar is not included in the calendarium: it only contains the Persian, Arabic and Syriac calendars. The two headings in larger writing indicate the Arabic and the Persian months. But the corresponding columns of the calendarium, of the Arabic and Persian calendars, as well as of the Syriac calendar, do not begin with day one, but start on the first line with a day numbered higher than one. This means that none of them served as the basis for the month contained in any one page. The dates in the Persian calendar are based on the era of Yazdgird. Thus, the only plausible assumption is that the months contained in each page are based on the Jalālī calendar. The position of the Sun in the first line of the page, indicating the first day of the month, is not at the beginning of a zodiacal sign. Therefore, the months were not regulated according to the entry of the Sun into new signs, as it is stated in the Sanjarī Zīj. The alternative would have been to keep the old system of twelve months of thirty days, with additional epagomenal days filling the gap before the New Year. Indeed, if one counts backwards from the months of the two fragments to the beginning of the first month, one ends up at the day of the vernal equinox. This was the main point of Malikshāh's reform of the calendar, to put *nawrūz* back in its proper place in time. This was accomplished in the yearbook of 1182/1183. Since the beginning of the yearbook is missing, we cannot tell if the year based on the era of Malikshāh was even mentioned.

The next example of a Jalālī date is a deluxe horoscope. It is the famous horoscope of Iskandar Sultan, a grandson of Tīmūr. It is one of the most beautiful illuminated Persian manuscripts of its age, kept in the Wellcome Library.[37] The birth date of Iskandar Sultan is given in five calendars:

'Monday, 3 Rabīʿ I 786 of the Hijra,

corresponding to 15 Urdibihisht, the Jalālī month, year of Malikshāh 306,

conforming to 17 old month Murdādh, Yazdgird year 753

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36 Idem, 'The Arabic Ephemeris for the Year 1149/1150 CE (P.Cambridge UL Inv. Michael. Chartae D 58) and the Arabic Baḫnīṯas, Greek Παχνίτης and Coptic ⲡⲁϣⲟⲛⲥ', *Chronique d'Égypte* 90.179 (2015), pp. 207–24, esp. 216–217, figg. 1–2.

37 F. Keshavarz, 'The Horoscope of Iskandar Sultan', *Journal of the Royal Asiatic Society* 116 (1984), pp. 197–208; L.P. Elwell-Sutton, 'A Royal Timūrid Nativity Book', in R.M. Savory and D.A. Agius (eds), *Logos Islamikos: Studia Islamica in honorem Georgii Michaelis Wickens* (Toronto: Pontifical Institute of Mediaeval Studies, 1984), pp. 119–36; F. Keshavarz, *A Descriptive and Analytical Catalogue of Persian Manuscripts in the Library of the Wellcome Institute for the History of Medicine* (London: Wellcome Institute for the History of Medicine, 1986), pp. 396–99 no 224; A. Caiozzo, 'The Horoscope of Iskandar Sultān as a Cosmological Vision in the Islamic World', in G. Oestmann, H.D. Rutkin, and K. von Stuckrad (eds), *Horoscopes and Public Spheres: Essays on the History of Astrology* (Berlin: Walter de Gruyter, 2005), pp. 115–44; N.M. Tourkin, 'Astrological Images in Two Persian Manuscripts' in N. Allan (ed.), *Pearls of the Orient: Asian treasures of the Wellcome Library* (Chicago: Serindia, 2003), pp. 105–9; S. Tourkin, 'L'Oroscopo di Shāh Tahmāsp', in S.R. Canby and J. Thompson (eds), *A caccia in Paradiso: Arte di corte nella Persia del Cinquecento* (Milano: Skira, 2005), pp. 327–31; S. Tourkin, 'The Horoscope for Shah Tahmāsp', in S.R. Canby and J. Thompson (eds), *Hunt for Paradise: Court Arts of Safavid Iran 1501–1576* (Milan: Skira, 2003), pp. 327–331.

identical with 25 Rūmī month Nīsān, year of Iskandar 1695,

calendar of the Chinese people [...] xin wei (辛未) [day]'

The dates in the three traditional calendars all correspond to 25 April 1384. The year 306 of Malikshāh leads to an epoch of 1079 CE. The Chinese date given agrees with the date in the Imperial Chinese calendar.[38]

In this context, variation seems to be a value in and of itself. It can be seen in the varying colours at the beginning of each dating phrase, and the synonyms used for 'corresponds to'. The manuscript contains 86 lavishly illuminated folios. The five redundant calendrical dates can be interpreted as a form of chronological eloquence.

The Iskandar horoscope is singular both in the length of the text and the quality of the decoration. The closest in length to the horoscope of Iskandar Sultan is the horoscope of Shāh Tahmasp, with 50 folios.[39] It also contains the date of the horoscope in the Jalālī calendar: Wednesday 19 Isfandarmuz 435. Further calendars used for the date are the Hijrī calendar, the Alexandrian calendar with the Seleucid era, the Persian calendar with the era of Yazdgird III, and the Chinese calendar:

26 Dhū l-Ḥijja 919 AH

22 Shubāt 1825 AS

17 Tīr 883 AY

28 I 88.639.930 AC.

They all correspond to 22 February 1514 AD in the Julian calendar, which is a Wednesday.

Other deluxe horoscopes typically contain only a few pages.[40] However, their history is still barely explored and more examples of the type of the horoscope like Iskandar Sultan's may come to light in the future.

In the 15th century, a new type of deluxe yearbooks came into use.[41] Most are in Persian and Turkish, and only few exist in Arabic. A relatively early example can be found in a codex in the

38 S. Fang, *Zhongguo shi liri he Zhong xi liri duizhao biao* [中国史歷日和中西歷日對照表] (Shanghai: Shanghai cishu chubanshe, 1987), p. 585; for the Chinese calendar in Islamic context see: B. van Dalen, E.S. Kennedy, and M.K. Saiyid, 'The Chinese-Uyghur Calendar in Ṭūsī's Zīj-i Īlkhānī', *Zeitschrift für Geschichte der arabisch-islamischen Wissenschaften* 11 (1997), pp. 111–51; E.S. Kennedy, 'The Chinese-Uyghur Calendar as Described in the Islamic Sources', *Isis* 55 (1964), pp. 435–43; Ch. Melville, 'The Chinese-Uyghur Animal Calendar in Persian Historiography of the Mongol Period', *Iran* 32 (1994), pp. 83–98.

39 S. Tourkin, 'L'Oroscopo di Shāh Tahmāsp', in S.R. Canby and J. Thompson (eds), *A caccia in Paradiso: Arte di corte nella Persia del Cinquecento* (Milano: Skira, 2005), pp. 327–31.

40 For an example see A.T. Adamova and M. Bayani, *Persian Painting: The Arts of the Book and Portraiture* (London: Thames & Hudson, 2015), pp. 28–40 no 2.

41 For a list with 78 items see A.T. Şen, *Astrology in the Service of the Empire: Knowledge, Prognostication, and Politics at the Ottoman Court 1450s–1550s* (Ph.D. thesis, University of Chicago, 2016), p. 353ff.

Biblioteca Medicea Laurenziana (MS Or.027).[42] It contains a number of leaves of one yearbook for the year 1450, mixed up with leaves of a later yearbook. The text is in Ottoman Turkish. Here, the Jalālī dates are visible in a separate column.[43] It is striking that it is not added to the calendarium with the traditional calendars, but rather placed to the left of the columns of the holidays, as if the scribe did not want to disrupt the traditional order of the columns. On the first day of the first month the sun is close to the beginning of Aries. But on the first day of the tenth month, the sun is in 24° of Capricornus. As in the yearbook of 1182 CE, the months have a fixed length of 30 days, and generally do not coincide with the entry of the sun into a zodiacal sign.

The first known Arabic case of this type of yearbook is an almanac for the year 1601/1602 CE (MS Venice, Biblioteca Marciana, Or. 84 (=14)). This calendarium contains three traditional calendars, the Arabic, the Roman, and the Coptic. Separated by two columns is the column with the Jalālī dates. The script is unclear, but it is most likely called *al-sulṭānī*. In the top left field, year 524 is written in green and red. It is close to the column of the Jalālī dates and, indeed, if subtracted from the Julian year 1603, we result with the era of 1079 CE. The older Persian calendar is absent in this almanac. One could speculate that it had become obsolete by then, but the evidence disproves this claim. In the numerous yearbooks from later years, the older Persian calendar is a regular encounter. An astronomical ephemeris without an astrological part (Berlin Staatsbibliothek, or. quart. 211, fol. 1r) provides a good example.[44] The calendarium contains seven calendars. Among them are the four traditional calendars: the Arabic, Coptic, Greek (*rūmī*) and older Persian calendars. Additionally, the Latin calendar is included and labeled as 'gentile' (*ʿajamī*). Also included is the Hebrew calendar, a rare occurrence in an ephemeris. Finally, the Jalālī calendar is included in the calendarium. The first leaf is missing, and on the remaining pages there is no dating year. The first page contains the data for the second month Ṣafar of the Arabic calendar. The value for the first day and its equivalences in the other calendars are as follows:

WD	Ṣafar	Pachons	Greek Nīsān	April	Persian Ādhar	Hebrew Sivan	Jalālī Urdhībihisht
Fr	1	4	29	29	1	1	22

The solar, lunar and planetary positions point to the date of Friday 11 May 1804 in the Gregorian calendar (29 April in the Julian calendar; JD 2380088). All the dates are correct. In the Persian calendar that is used, the epagomenal days are placed after the 8th month Ābān, and not at the end of the year. This indicates that very old chronological tables were used. The spring equinox in 1804 was on 21 March (Gregorian), which is 51 days before 11 May. 22 Urdhībihisht is 51 days later then 1st of Farwardīn. Therefore Nawrūz in the Jalālī year 726 was at the true equinox.[45]

[Figure 5.1: Berlin Staatsbibliothek, or. quart. 211, fol. 1r. Arabic Ephemeris for the year 1804 CE with dates in the Arabic, Coptic, Syriac, Julian, Persian (Yazdgird), Hebrew, and Jalālī calendars (Public Domain Mark 1.0; image: Staatsbibliothek zu Berlin - PK, https://digital.staatsbibliothek-berlin.de/werkansicht?PPN=PPN752162500&PHYSID=PHYS_0005)]

42 Not mentioned by Şen, *Astrology in the Service of the Empire*. Images: http://teca.bmlonline.it/ImageViewer/servlet/ImageViewer?idr=TECA0001485178#page/1/mode/1up, accessed 5 November 2017.

43 For text and translation see Appendix III.1.

44 For text and translation see Appendix III.2.

45 B. Spuler, *Wüstenfeld-Mahler'sche Vergleichungs-Tabellen zur muslimischen und iranischen Zeitrechnung: mit Tafeln zur Umrechnung orient-christlicher Ären* (Wiesbaden: Steiner, 1961), p. 39.

6. The Jalālī calendar in a broader context of time practices[46]

These examples of occurrences of Jalālī dates show that the Jalālī calendar was exclusively used in documents pertaining to astronomical and astrological activities. But it would be wrong to conclude that its significance was only in the minds of astronomers and astrologers. This needs to be seen in a broader social context. More general thoughts on time concepts in the pre-modern Islamic world may help to understand its significance.

Jacques Le Goff's famous article 'Temps de l'église et temps du marchand', published in 1960, is still a classic in medieval studies. Even if some of his claims were disproved by later research, his distinction between 'church time' and 'civil time' is still regarded as useful.[47] The city tower of Aire-sur-la-Lys, built in 1355 CE, exemplified the beginning of a new kind of time, professional time.[48] Its bells did not ring for prayers, but for commercial transactions and the labor of workers. For the merchant, the time of business gave a structure to his daily life, while the bells of the church served another horizon of existence. This conception can easily be applied to the pre-modern Islamic world, but with the more generic categories of 'civil time' and 'ritual time'. In the public sphere, civil time and ritual time existed both in parallel.

As an example, a sundial inscribed with the name of Nūr al-Dīn al-Zangī in Syria as its maker is said, in the same inscription, to have been made 'for the knowledge of the seasonal hours and the hours of the prayers'; seasonal hours refer to civil time.[49] However, this dual model of time can be supplemented from texts in early paper documents from 10th-century Egypt and later, which attest a third type of time, cosmic time, and show how it was managed in everyday life. These are the so-called almanacs, which contain daily entries for a particular year with information of an astronomical and astrological nature. Central to the almanacs were predictions based on the aspects of the moon with the sun and the planets. The theory behind these predictions was a part of astrology called *katarchai* in Greek, *ikhtiyārāt* in Arabic and *electiones* in Latin. The earliest available example is a paper fragment of an almanac for the year 297 of the Hijra.[50] A similar almanac, made for the year 334 of the Hijra, contains additional information, by adding the hour of day or night when the aspects take place.[51] This seems to allow for even more precise scheduling of actions, or avoidance of actions, at particular hours. More concrete descriptions can be found in an almanac for the Coptic

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46 This final section is an updated version of the conclusions in J. Thomann, 'Tools of Time: Devices for Organizing Public and Private Life in the Premodern Islamic World', in A. Pellitteri et al. (eds), *Re-defining a Space of Encounter. Islam and Mediterranean: Identity, Alterity and Interactions: Proceedings of the 28th Congress of the Union Européenne des Arabisants et Islamisants* (Leuven: Peeters, 2019), pp. 97–105.

47 G. Dohrn-Van Rossum, *History of the Hour: Clocks and Modern Temporal Orders* (Chicago: University of Chicago Press, 1996), pp. 13–14, 226–31; M.S. Champion, *The Fullness of Time: Temporalities of the Fifteenth-Century Low Countries* (Chicago: The University of Chicago Press, 2017), pp. 8–9; Ch. Kiening, 'Mediating the Passion in Time and Space', in C. Kiening and M. Stercken (eds), *Temporality and Mediality in Late Medieval and Early Modern Culture* (Turnhout: Brepols, 2018), pp. 115–46, esp. 140.

48 J. Le Goff, 'Au Moyen Age: Temps de l'Eglise et temps du marchand', *Annales. Histoire, Sciences Sociales* 15 (1960), pp. 413–33, esp. 424; idem, 'Merchant's time and church's time', in J. Le Goff, *Time, Work and Culture in the Middle Ages* (Chicago: University of Chicago Press, 1989), pp. 29–42, esp. 35.

49 P. Casanova, 'Le montre du sutan Noûr ad Dîn', *Syria* 4 (1923), pp. 282–99; Thomann, 'Tools of Time'.

50 J. Thomann, 'A Fragment of an Unusual Arabic Almanac for 297 AH/910 CE (P.Berl. inv. 12793)', in S. Souderbala, S. Denoix, and M. Malczycki (eds), *New frontiers of Arabic papyrology: Arabic and Multilingual Texts from Early Islam* (Leiden: Brill, 2017), pp. 179-96.

51 Idem, 'From Katarchai to Ikhtiyārāt', pp. 344–45, fig. 3.

year 707 (990/991 CE),[52] where besides more general prescriptions, e.g. 'contacts with the authorities' and 'to accomplish messages', are found.

These documentary examples have no archaeological context. All we know is that they were probably found in the region of the Fayyūm or further to the south. However, a number of almanacs were found among the documents from the Cairo Geniza.[53] They are very similar in layout and content to the almanacs found elsewhere in Egypt. In one single case, an astrological document was found in a regular excavation. Some hundred Arabic documents were excavated in al-Fustat, among them an astrological responsum.[54] The building where it was found belonged to a group of houses which have been characterized as 'the workers' quarter'.[55] The presence of an astrological document at such a place seems to indicate that astrology of an average level was not limited to the elite or the rich, but found its way to the middle class.

The evidence thus suggests that a third type of time has to be taken into consideration: cosmic time. It had its public appearance too. The Talisman gate in Baghdad presents the divine person of the moon as the dominant ruler of cosmic time, between the divine beings of the lunar nodes.[56] In this conceptual model, civil time serves interaction within society, ritual time is directed towards the transcendental aspect, and cosmic time keeps contact with the heavenly rulers, but is directed to the individual itself. Concerning rulership, civil time is implicitly atheistic, ritual time is decidedly monotheistic, and cosmic time is glaringly polytheistic. In structure, civil time is homogeneous, ritual time is dichotomous, and cosmic time is highly heterogeneous. Civil time manages interpersonal activity, ritual time manages otherworldliness, and cosmic time promises to manage self-fulfillment.[57] Moreover, the threefold concept of time can be applied to the three groups of calendars considered here. The lunar calendar based on the Hijra era was indispensable for the organization of rituals in the course of the year. Various, different simple solar calendars were used for different practical purposes in civil life. Finally, the Jalālī calendar was used exclusively in connection to astrological practices, and served to plan personal time choices in order to maximize individual success.[58] For a large part of society, this seems to have been guaranteed by the stars that were thought to govern all aspects of human life. To stay in synchronism with the heavens was for many the preferred way of life.[59] The Jalālī calendar was designed to achieve this.

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52 Idem, 'Almanach für das koptische Jahr 707 (990/991 n. Chr.)', in A. Zdiarsky (ed.), *Orakelsprüche, Magie und Horoskope: wie Ägypten in die Zukunft sah* (Nilus 22; Wien: Phoibos-Verlag, 2015), pp. 140-41.

53 B.R. Goldstein and D. Pingree, 'Astrological Almanacs from the Cairo Geniza', *Journal of Near Eastern Studies* 38 (1979), pp. 153–75 and 231–56; idem, 'Additional Astrological Almanacs from the Cairo Geniza', *Journal of the American Oriental Society* 103 (1983), pp. 673-90.

54 D.S. Richards, 'Written documents', in W. Kubiak and G.T. Scanlon (eds), *Fusṭāt excavation final report II* (American Research Center in Egypt Reports 2; Wiona Lake: Eisenbrauns, 1989), pp. 4–80, esp. 68.

55 G.T. Scanlon, 'Fustat', in E.M. Meyers (ed.), *The Oxford Encyclopedia of Archaeology in the Near East* (New York: Oxford University Press, 1997), pp. 365– 68, esp. 367.

56 F. Sarre and E. Herzfeld, *Archäologische Reise im Euphrat- und Tigris-Gebiet III* (Forschungen zur islamischen Kunst 1; Berlin: Reimer, 1911), pl. X–XI.

57 More extensive arguments and fuller documentation of this conceptual model are found in J. Thomann, 'Ritual Time, Civil Time, and Cosmic Time: Three Co-Existing Temporalities in Premodern Islamic Society', *Kronoscope* 20 (2020), pp. 41–63.

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58 For the 'egocentric perspective' of astrology see S.M. Mozaffari, 'The Effect of Astrological Opinions on Society: A Preliminary View', *Trames* 16 (2012), pp. 359–68, esp. 360.

59 The expression is borrowed from the book title of David King's work *In Synchrony with the Heavens: Studies in Astronomical Timekeeping and Instrumentation in Medieval Islamic Civilization* (Islamic Philosophy, Theology and Science 55; Leiden: Brill, 2004-2005).

Appendix I: Arabic texts

I.1. Inscription, 1041 CE, of Varuh[60]

كتابت (كتبت ؟) يوم الثلثاء من أيّام شهر جمادى الأولى سنة ثلث و ثلثين و أربعمائة أمر بها / تشريفا للتكين الأجلّ السيّد العالم العادل معزّ الدولة ارسلان تكين أبو الفضل العبّاس من / وَيّد العدل ايلك ابن الأمير نصر بن علىّ سعيد خان مولى أمير المؤمنين والى اسفره رودبار / رم (؟) أعزّ الله شرفه و غفر الله له و لوالديه / وألحقه برسوله محمّد صلّى الله عليه وآله و أصحابه و أهل بيته / فى دى ماه الفرس سنة عشر و أربعمائة فى كانون الأوّل الروميّة

Inscription of Tuesday/the third of the month of Jumādā I of the year four hundred thirty-three [December 29, 1041]. It was ordered to honor the most exalted prince, the wise and just lord, Muʿizz al-Dawla Arslān Tikīn Abū l-Faḍl al-ʿAbbās ibn Muʾayyad alʿAdl Ilik, son of the amir Naṣr ibn ʿAlī Saʿīd Khān, client of the Commander of the Faithful, by the governor of Isfara, Rūdbār and Rūm [?], may God glorify his nobility and pardon him and his parents and join him to His prophet Muḥammad, Gods's blessing be upon him and his family and his companions and the people of his house, in the Persian month Day in the year four hundred and ten and Kanūn I of the Greeks.

I.2 Al-Khāzinī, *al-Zīj al-Sanjarī*[61]

والخامس من التواريخ المشهورة سنو الكبائس السلطانية الملكشاهية

ولمّا كان أمر السنة الشمسية استيفاء الفصول الأربعة وعرد النسو خرج

الأمر العالي السلطاني الملكشاهي أنار الله برهانه بافتتاح التقويم من لدن بلوغ مركز

60 Text edition and translation by S. Blair, *The Monumental Inscriptions from Early Islamic Iran and Transoxiana, Studies in Islamic Art and Architecture* (Supplements to Muqarnas 5; Leiden: Brill, 1992), p. 115 no. 42.

61 Text established by the author, based on MS Istanbul, Süleymaniye Kütüphanesi, Hamidiye 859.

النير الأعظم نقطة الاعتدال الربيعي وكانت سنو التواريخ غير مطابقة لها فأردنا الحاقها

لها فأردنا لخاقها إليها ليسفعك؟ على المقوم افتتاحها لاستخراج

أوساط حركات الكواكب بأي تأريخ أراده هو على محاذاة السنة

الشمسية وأولها يوم الأحد من شعبان سنة ثامن وستّين وأربعماة

وافتتاحها اليوم الّذي ينزل مركز الشمس نقطة الاعتدال

الربيعي وأسماء شهورها فارسيّة وأيامها بحسب دخول

الشمس أوائل البروج بخلاف الروم والفرس ودورها

٢٢٥ سنة شمسية يقع فيه نجـ يوما كبيسة منها

خمس وأربعون رابونا وثمانية خاموسا ومجموعها نجى .:

Translation:[62]

The fifth famous calendar is the leap year of Sultan Malikshāh. When he had ordered [to determine] the solar year, to treat exhaustively the four seasons and the return of growth, the order of Sultan Malikshāh – God may enlighten his inspiration – was issued 'to begin an astronomical table from [the time] onwards when the center of the great light [i. e. the sun] had reached the point of the spring equinox. The years of the calendars were not adequate for that. We want to add [days] to them, in order to make it easy for the assessor to deduce the mean motion of the planets for any date he wants parallel to the solar year. Its beginning is Sunday of Shaʿbān in the year 468. Its beginning was the day at which the center of the sun reaches the point of the spring equinox. The names of their months are Persian. Their days are [determined] according to the entering of the sun into the beginnings of the zodiacal signs, as opposed to [systems of] the Greeks and the [ancient] Persians. The cycle is 225 solar years, into which 53 leap days fall, 45 of which are in the fourth [year after the last leap year], and 8 are in the fifth [year after the last leap year].

I.3. Ibn al-Athīr[63]

سنة ٤٦٧

وفيها جمع نظام الملك والسلطان ملكشاه جماعة من أعيان المنجّمين وجعلوا النيروز أوّل نقطة من الحمل ، وكان النيروز قبل ذلك عند حلول الشمس نصف الحوت وصار ما فعله السلطرن مبدأ التقواويم .

وفيها أيضاً عمل الرصد للسلطان ملكشاه واجتمع جماعة من أعيان المنجمين في عمله منهم عمر بن إلباهيم الخيامي وأبو المظفر الاسفزاري وميمون بن النجيب الواسطي وغيرهم وخرج عليه من الأموال شيء عظيم وبقي الرصد دائراً إلى أن مات السلطان سنة خمس وثمانين وأربعمائة فبطل بعد موته .

62 Translation by the author.

63 Text: Ibn al-Athīr, ʿAlī ibn Muḥammad, *al-Kāmil fī l-taʾrīkh* (ed. Abū l-Fidāʾ ʿAbdallāh al-Qāḍī; Beirut: Dār al-kutub al-ʿilmiyya, 1987–2003), vol. 8, pp. 408-9.

Translation:[64]

Year 467 [= 1074 CE]

In this year Niẓām al-Mulk and Sultan Malikshāh gathered together a group of the most distinguished astronomers, and they set the first day of the year (*nayrūz*) at the beginning of Aries, whereas that day had come to coincide with the sun's entry into the middle of Pisces. This act of the Sultan established the beginning of the ephemerides (*takwīm*). Likewise, in this year the observatory was built (*ʿumila l-raṣadu*) for Sultan Malikshāh, and a group of outstanding astronomers came together for its foundation, among whom were ʿUmar ibn Ibrāhīm al-Khayyāmī, Abū l-Muẓaffar al-Asfizārī, and Maymūn ibn Najīb al-Wāsiṭī, and others. An enormous amount of money was spent for this purpose. The observatory continued functioning until the death of the Sultan in 485, and it came to an end after his death.

I.4 Astrolabe, 1271 CE[65]

أ - سنة قسج ملكشاهى / خم يزدجرديّة غثغب اسكندر روميّة / صنعة محمود بن علىّ بن يوشع الـ ...ـرى سنة خسط هجريّة / برسم خزانة الصدر المعظّم الصاحب الأعظم المؤيّد العالم العادل ملك الأمراء خسرو الآفاق بهاء الدولة و الدين شمس الإسلام و المسلمين غياث الملوك و الخواقين الحسن بن علىّ الشديد أعزّ الله أنصاره و ضاعف (؟) جلاله

Translation

The year 193 Malikshāhī / [the year] 649 of the Yazdjirdiyya (era), 1583 of the Iskandar Rūmiyya (era) / Constructed by Maḥmūd ibn ʿAlī ibn Yūshaʾ al-..ri in the year 669 Hijriyya (era) / For the Museum of the honored Prime Minister the supreme lord, the assisted [by God], the wise, the just, the king of the amirs, the Khusraw of the quarters of the world, the splendor of the state, and of the faith, the sun of the Islam and of Muslims, the succor of princes and lords, al-Ḥasan ibn ʿAlī al-Shadīd: may God glorify his friends, and double his dignity.

I.5 Inscription, 948 CE

64 Translation by A. Sayılı, *The Observatory in Islam and its Place in the General History of the Observatory* (Ankara: Türk Tarih Kurumu Basımevi, 2nd ed., 1988), p. 161.

65 Text edition and translation by W.H. Morley, *Description of a Planispheric Astrolabe Constructed for Sháh Sultán Husain Safawí, King of Persia, and Now Preserved in the British Museum; Comprising an Account of the Astrolabe Generally, with Nores Illustrative and Explanatory: To which are Added, Concise Notices of Twelve Other Astrolabes, Eastern and European, Hitherto Undescribed* (London: Williams and Norgate, 1856), pp. 33 and 35

Text (excerpt):[66]

(٢١) [...] و كتب يوم الإثنين لخمس حه ا (كذا) [= خلون ؟] من

(١٣) رجب سنة سبع و ثلثين و ثلثمائة و بالفارسيّة (؟)

(١٤) ما ين دين و رحر (؟) سنة سبعة اعشر (كذا)

(١٥) و ثلثمائة و صلّى الله على نبيّه محمّد و سلّم

Translation:

(12) Written Monday 5 (or 6?)

(13) Rajab of the year 337, in the Persian [calendar]

(14) ... of the year 317. May God bless His prophet Muḥammad and salute him.

I.6 Inscription, 1203 CE

Text:[67]

هذا بناء القلعة [...] فى تأريخ المرداذ ماه سنة ستّمائة

Translation:[68]

This is the construction of the fortress [...] on the date Murdād māh of the year 600

I. 7 Inscription on an astrolabe, 1388 CE

Text:[69]

أ - (١) صنعة

(٢) جعفر بن عمر الكرمانى

66 Text edition by L. Kalus and C. Guillot, 'Réinterprétation des plus anciennes stèles funéraires islamiques nousantariennes: III. Sri Lanka', *Archipel* 72 (2006), pp. 15–68 (with French translation); E. Combe, J. Sauvaget, and G. Wiet (eds), *Répertoire chronologique d'épigraphie arabe (RCEA)* (Cairo: Imprimerie de l'IFAO, 1931–). Here: *RCEA* 4 (1933), pp. 113–14 no 1435.

67 Text edition: Combe, Sauvaget, and Wiet, *RCEA* 9 (1937), pp. 257–58 no. 3580 (with French translation).

68 Translation by the author.

69 Text edition: Combe, Sauvaget, and Wiet, *RCEA* (1991) 18, pp. 107–8 no 790 011 (with French translation).

- ب -(١) فى سنة

(٢) ذص الهجريّة و ذنح (؟) اليزدجر[ديـ]ـة (اليزدجرديّة)

Translation:[70]

Work of Jaʿfar ibn ʿUmar al-Kirmānī in the year 790 of the Hijra, and 758 of Yazdjird

I. 8 Inscription, 1393 CE

Text:[71]

فى سنة

(٢) ذصو الهجريّة

(٣) و ذسد اليزدجرديّة

Translation:[72]

In the year 796 of the Hijra, and 764 of Yazdjird

I.9 Inscription, 1423 CE

Text:[73]

أ - فى سنة ضكز الهجريّة

- ب - و ذصح اليزدرجرديّة

Translation:[74]

In the year 827 of the Hijra, and 798 of Yazdjird

I.10 Inscription, 1430 CE

70 Translation by the author.
71 Text edition: L. Kalus, *Thesaurus d'Épigraphie Islamique* (http://www.epigraphie-islamique.org, assessed 19 August 2020).
72 Translation by the author.
73 Text edition: L. Kalus, *Thesaurus d'Épigraphie Islamique* (http://www.epigraphie-islamique.org, assessed 19 August 2020).
74 Translation by the author.

Text:[75]

فى سنة ضلد

ـ(٤) الهجرية و ض ه اليزدرجدية

ـ(٥) و غذلجـ الاسكمدرية

Translation:[76]

In the year 834 of the Hijra, and 800 of Yazdjird, and of 1633(?) of Alexander

I.11 Inscription, 1522 CE

Text:[77]

فى سنة

ـ(٢) ظكط الهجريّة

ـ(٣) ضصب اليزدجرديّة

Translation:[78]

In the year 929 of the Hijra, and 892 of Yazdjird

I.12 Inscription, 1573 CE

Text:[79]

ـ(٧) فى سنة ظ فا هجريّة

(٨) ٩٨١ و ظ نب

(٩) يزدجرديّة

75 Text edition: L. Kalus, *Thesaurus d'Épigraphie Islamique* (http://www.epigraphie-islamique.org, assessed 19 August 2020).

76 Translation by the author.

77 Text edition: Kalus, *Thesaurus d'Épigraphie Islamique*.

78 Translation by the author.

79 E. Savage-Smith, *Islamicate Celestial Globes. Their History, Construction, and Use* (Smithsonian Studies in History and Technology 46; Washington, D.C.: Smithsonian Institution Press, 1985), p. 223, no. 9. Text edition: ibid., pp. 286–87.

Translation:[80]

In the year 981 of the Hijra, and 952 of Yazdjird

I.13 Ephemeris of 1182 CE

Text:

	1	2	3	4
i	اجتماع الأوّل [...]			المتهلّ
ii		الأيّام		ه
iii		من ربيع الأوّل		ك
iv		من آب		يا
v		من مهر ماه		يد
vi		مهر ماه أوّل يوم السبت	الشمس	د كد مز
vii			القمر	ا يه يا
viii			زحل	د كز نب
ix			المشتري	جـ يا مجـ
x			المرّيخ	يا كه يح
xi			الزهرة	ه ح ما
xii			عطارد	د ط ن
xiii			جوزهر	[جـ] يجـ مد
xiv			الساعات	[يجـ] يط
xv			الارتفاعات	[...]

Translation:

	i	ii	iii	iv	v	vi	vii	viii	ix	x	xi	xii	xiii	xiv	xv
1	Conjunction of Jumādā I [...]														

80 Translation: ibid., p. 223.

2		Days	of	of	of	Month Mihr, begin on Saturday									
3		[of the week]	Rabīʿ I	Āb	month Mihr	Sun	Moon	Saturn	Jupiter	Mars	Venus	Mer-cury	Node	Hours	Alti-tude
4		5	20	11	14	4 24 47	1 15 11	4 27 52	3 11 13	11 25 18	5 8 41	4 9 50	[3] 13 44	[13] 19	[..]

I.14 Ephemeris of 1603 CE

Text:[81]

[..]**رافقه** اليوم السادس والعشرين من مردادحد> ماه الفارسي اليزدجردي القديم **لاسمه** اليوم الأوّل من **فروردين ماه** الجلالي الملكي الشاهي السلجوقي سنة **٥٢٤** جلالية سلجوقيّة ملك ساه بن اولب قسلان [...]

xi	x	ix	viii	vii	vi	v	iv	iii	ii	i	
سنة **٥٢٤** **الإختيارات القمريّة**	فروردين ماه ««سلجقي	**أحوال الأيّام**	أحوال الجوّ	مواضع القمر	**العدد من برمهات قبطي**	العدد من آدار الرومي	**العدد من رمضان المعظم**	أيّام الأسبوع	المواسم اليوميّة	الأحكام الجزئيّة	1
اعتدال الزمان في سائر المعور	١	كلاب	**تغيير في الجوّ**	حوت	١٥	**١١**	٢٧	**خميس ١٢**	نوروز الملوك	**الأحكام**	2

Translation:[82]

[...] in company with it is day 26 of the old Persian month Murdād [in the era of] Yazdgird. In touch with it is day 1 of the Jalālī, Shāhī, and Salğuqī month Farwardīn in the year 524 Jalālī, Salğuqī year of Malik Shāh ibn Ūlp Qaslān [sic!] [...]

81 Text established by the author, based on MS Venice, Bibliotheca nazionale Marciana, or. 84 (=14), ff. 8r and 9r.

82 Translated by the author.

	i	ii	iii	iv	v	vi	vii	viii	ix	x	xi
1	Particular judgments	Daily feasts	Days of the week	Number of Rama-ḍān	Number of Ādār of the Greeks	Number of Barmahāt	Places of the moon	Quali-ties of the air	Quali-ties of the days	Saljuqī month Farwardīn	Year 523. Choices of the moon
2	Prescriptions	Nawrūz of the kings	Thursday 12	27	11	15	Pisces	Change of the air	Dogs [?]	1	Balanced time in the rest of the world

I.15 Ephemeris of 1804 CE (header and first day only)

Text (table turned here 90°anticlockwise) :[83]

	1	2
i	علامة صفر	و
ii	عدد صفر	١
iii	من دشنس قبطي	٤
iv	من نيسان رومي	٢٩
v	من أدريل عجمي	٢٩
vi	من آذر فابسي	١
vii	من سيوان عبري	١
viii	من أردبهشت جلالي	٢٢
ix	شمس	ك ٢ يز
x	قمر	يد ٣ ٣٩
xi	زحل	٢٩ ٦ كد
xii	مشتري	كح ٧ ب
xiii	مرّيخ	يه ١ لا
xiv	زهرة	د ٤ لب
xv	عطارد	يب ٣ كب
xvi	رأس	ط ١١ ب

83 Text established by the author, based on MS Berlin, Staatsbibliothek, or. quart. 211, f. 1r.

xvii	التوقيعات	سيوان عبري أوّل اللواقح بزرع الخيّار مولد داؤد

Translation:[84]

	1	2
i	Signs [of the week days] of Ṣafar	6
ii	Numbers [of days] of Ṣafar	1
iii	[Numbers] of [of days] of Coptic Bashons	4
iv	[Numbers] of [of days] of Greek Nīsān	29
v	[Numbers] of [of days] of foreign[85] Abrīl	29
vi	[Numbers] of [of days] of Persian Ādar	1
vii	[Numbers] of [of days] of Hebrew Sīwān	1
viii	[Numbers] of [of days] of Jalālī Urdibihisht	22
ix	Sun	20 **2** 17
x	Moon	14 **3** 39
xi	Saturn	29 **6** 24
xii	Jupiter	28 **7** 2
xiii	Mars	15 **1** 31
xiv	Venus	4 **4** 31
xv	Mercury	12 **3** 22
xvi	Head [of the Dragon]	9 **11** 2
xvii	Executions [of actions]	Hebrew [month] Sīwān; first fertilizations, together with the sowing of the winegrowers; birthday of [king] David.

84 Translated by the author.

85 Probably a reference to the ancient pagan Romans, as the Peoples of the Book have other calendars allocated to them here.

Appendix II: Persian texts

II.1 [Ps.-]ʿUmar Khayyām, *Nawrūznāma*

Text:[86]

بفرمود تا کبیسه کنند وسال بجایگاه خویش باز آرند . حکماء عصر از خراسان بیاورند ، و هر آلتي کث رصد را بکار آید بساختند از دیوار و ذات الحلق ومانند این ، و نوروز را بفرودین بردند ولیکن پادشاه را زمانه زمان نداد و کبیسه تمام نا کرده بماند

Translation:[87]

[Malikshāh] ordered the intercalation to be made and the year to be moved to its true place. The learned people of the age were brought from Khurasan, and each needed instrument, such as the wall [quadrant], armillary sphere, and other similar ones were constructed. Nawrūz was set up at Farwardīn, but the King did not live long enough and the intercalation remained incomplete.

II.2 Naṣīr al-Dīn al-Ṭūsī, *Zīj-i Īlkhānī*

Text:[88]

فصل پنجم در تاریخ محدث که انرا تاریخ ملکي خواهند

سلطان جلال الدوله ملکشاه بن الپ ارسلان

سلجوقي تاریخی دیگر نهاده است که اوّل

سال او روزی باشد که افتاب بحمل آمده

باشد یعنی اول نهار حقیقی و بعضي اول

هر ماه هم اول آمدن آفتاب گیرند بآن

برج که آن ماه نوبت آن برج باشد تا ماهها

شمسی حقیقی باشد وفصول سال حقیقی باشد

وماههارا نام هم نام ماههای پارسیان

باشد امّا ماههای پارسیان را بقدیم

86 Text: [ps.-]ʿUmar al-Khayyām, *Nawrūznāma*, p. 12.

87 Translation: Sayılı, *Observatory in Islam*, p. 163.

88 Text established by the author, based on MS Oxford, Bodleian Library, Hunt. 143.

مقيّد كنند واين ماهارا بجلالي مقيّد

كنند ومنجمان ماهها سى سى روز گيرند اسامي را تا عدد ايّام در اوراق تقويم

مختلف نباشد وپنجهء مسترقه را در آخر اسفندارمذ ماه گيرند و بهر جهار سال

يك روز كبيسه باشد وسال سيصد وشست وشش روز شود و جون هفت بار يا هشت؟

بار بجهار سال كبيسه افتذ يكبار پنج سال كبيسه افتذ و معرفت اوائل سالها

و كبائس با ستقرا معلوم شود و ما سيصذ سال را از اول تاريخ مدخل سالها در

جدولى نهاذيم و همحنين؟ عدد كبائس در جدول ديگر و جون تاريخي ديگر

معلوم باشد و تاريخ ملكى خواهند كه معلوم كنند آن تاريخ با روزها كنند و مابين

التاريخين از ان روزها بكاهند باقى روزها باشد از اول تاريخ ملكى آنرا بربرسيصد

وشست و پنج قسمت كنند وخارج قسمت در جدول عدد كبائس طلب كنند آنج؟ از عدد كبائس

بازاى آن عدد يا بيشتر عددى كه از خارج قسمت كمتر باشد در جدول يابند بعدد آن از ايام

باقى نقصان كنند خارج قسمت سالهاى تامه باشد و ايّام باقى از سال ناقصه بر سى قسمت

v

كنند تا ماههاى تامه حاصل آيد و باقى ايّام باشد از ماه حاضر و اگر خواهند كه از

تاريخ ملكى تاريخى ديگر بيرون آرند سالهاى تامه در سيصد وشست وپنج ضرب كنند

و با زاء ان سالها تا بيستر عددى كه از ان كمتر بود در جدول عدد كبائس بر حاصل ضرب

افزايند تا ايام سالها تامه شود عدد بس عدد ماههاء تام در سى ضرب كنند و بر ايّام

سالها تامه افزايند و روزها از ماه حاضر تا روز مطلوب بر ان افزايند جمله

ايام تاريخ ملكى باشد ما بين تاريخ ملكي و تاريخ مطلوب برو افرايند تاريخ مطلوب

برو افزايند تاريخ مطلوب شود بر وجه مذكور با سال و ماه و روز مطلوب كنند

و ما جدول بجهت معرفت مدخل تاريخ ملكي نهاده ايم تا آنج با زاى مجموعه ومبسوطه

از ان جدول يابند مدخل سال مطلوب بود وجدول انيست؟ كث بر هنح؟ ديگرست

Translation:[89]

89 Translation by the author.

Fifth chapter: On the new calendar which they call the Malikī calendar

The Saljuq Sultan Jalāl al-Dawla Malikshāh ibn Alp Arslan established another calendar. The beginning of its year is the day on which the sun comes into Aries, meaning the beginning of the real bright day; and some people also take as the beginning of each month the entry of the sun into the zodiacal sign, such that the month is the period of that zodiacal sign, so that the months are true solar ones. The seasons of the year are true [solar ones]. The months also have the names of the months of the [ancient] Persians. The months of the [ancient] Persians are specified as 'old' (*qadīm*), but these months are specified as 'Jalālī'. The astrologers (*munajjimān*) make the months 30 days each for the people (*asāmī*), in order that the numbers of days on the leaves of an almanac should not be different. They put the five supplementary days at the end of the month Isfandārmudh. Every four years there is one leap day, and the year has 366 [*sīṣad* rather than *sih ṣad* for 300] days. When seven times, or eight times the intercalation in four years has passed, one fifth-year intercalation takes place. The beginnings of the years and the intercalation is made known by diligent search. We have put in a table the beginnings of the year for 300 years from the epoch (*tārīkh*) onwards. And in the same way [we] have also [put] the number of intercalations into another table. If a date [in] another [calendar] is known, and one wants the Malikī date to be known, one converts (*kunand*) this date into days. One has to subtract the difference between the two epochs (*al-tarīkhayn*). The reminder are the days from the beginning of the Malikī calendar. One divides these by 365. One searches the result of the division in the table of the number of intercalations. One finds in the table... this number or a greater number which is smaller than the result of the division [?]. One subtracts this number from the remaining days. The result of the division is in complete years. One divides the remaining days of the incomplete year by 30. The remaining days are from the present month. If one wishes to find out a Malikī date in another calendar, one multiplies the complete years by 365. With this result or a greater number which is smaller than that number [?], one adds [the number] in the table of the numbers of intercalations to (?) the result of the multiplication, to the end that years are complete. One multiplies the number being the number of completed months by 30. One adds it to the days of the complete years. One adds to it the days of the present month together with the wanted days [?]. The sum are the days in the Malikī calendar. We add to it the difference between the Malikī epoch and the wanted epoch, adding [up to] the wanted date [?], being the wanted date [?]. One does it with year, month, and day in the way just mentioned. We have established a table for knowing the beginning of the Malikī calendar. Thus, one finds the collected and single [years] from this table, [which] are the wanted years. The table ... [?] is different.

II.3 Horoscope of Iskandar Sultan

Text:[90]

لدن ذكر تاريخ الولآدة المبارك

90 Text established by the author, based on manuscript London, Wellcome Medical Library, MS Persian 474.

در بهترين و قي و شد نفرين ساعتي از شب دوشنبه سيوم ربيع الاول سنه ست و ثمانين وسبعمائه

الهجريه موافق با نر دهم اردبهشت ماه جلآلي سنه ست وثلثمائه الملكشآهيه منآسب هفدهم مردادمآه

قديم سنه ثلاث وخمسين و سبعمائه اليزدجرديه مُطابق بيست و پنجم نيسان الرومي سنه الف و

خمس و تسعين وستمائه الاسكندريه تآريخ خطآئيآن صد و چهار فنك وعشري كد شبه از كه هشتم از

جآع دوازدهم كه انرا نخطاتي خاتي طنغوز خوآنند از روز هشتم انه دور ستيني كه انرآ بقاتى سن و تي

خوآنند و بتركي قوي وبحسب دور چهآرم كه اعتماد اهل قتآبران است روز چهآرم كه انرا پِنْ خوانند

موصاف به خي كدشته از مدخل حقيقى دُورد نجآي سه روز و جهآر هزار و دو يست و بآنرده

فنك كث ارقام ان اينست جـ ا ي يه و كدشته از مدخل قسم كفووُو ده روز و هشت هرآ و شيصد و هفتاد

Translation:[91]

[...] account of the date of blessed birth [... evening of Monday, 3 Rabīʿ al-awwal of the Year 786 of the Hijra, corresponding to 15 Jalālī month Urdībihishj of the year 306 of Malikshāh, in accordance with 17 old month Murdādmāh of the year 753 of Yazdgird, coinciding with 25 Roman month Nīsān of the year 1695 of Alexander. The date of the Chinese [people]: 104 1/10 *fink* elapsed of the 8th *kih* of the 12th *chāgh*, which is called in Khatāʾī *khāy* [and in turkish] *ṭunghūz*, of the eight day of the sexagesimal cycle, which in Tatāʾī [sic] is called *sin wī*, and in Turkish *qūy*. According to the fourth cycle, which is favored by the people of Qatā, on the fourth day called *pin*, described as *khī*, 3 days and 4,215 *fink* (in figures 3, 1, 10, 15) past the beginning (*madkhal*) of *dūrdinj āy*, and 10 days and 8677 *fink* (in figures 10, 2, 24, 37) past the beginning of the section (*qism*) of Khavin cycle, which year is called *kā zha* [chin. *jia zi*] in Khaṭāʾī and of the *kiskū* of *sījqān* in Turkish. There had elapsed since the creation of the world 8863 complete *win*, and of the incomplete *win* 9860 years, the above-mentioned year being the incomplete year.

91 The first part of the translation is by the author, the second part on the Chinese calendar by Elwell-Sutton, 'A Royal Timūrid Nativity Book', pp. 121–23.

III Turkish Texts

III.1 Ephemeris of 1450 CE

Text.[92]

فروردين ماه جلالي اوّله يوم الأربعاء							ايام فرس	ايام روم	ايام عرب	ايام جمعات	اعياد	ايام جلالي
گنس	اي	زحل	مشتري	مرّيخ	زهره	عطارد						
ط ه ه	ي كو ل	ه ك ب	ي كو لجـ	يا د نب	يا د نب	ه جـ ب	يح	يا	كو	د	گنش حمل برجنه گجدي	ا

Translation:[93]

Jalālī days	Feasts	Days of the week	Days of the Arabs	Days of the Greeks	Days of the Persians	Jalālī month Farwardīn, its beginning on Wednesday						
						Sun	Moon	Saturn	Jupiter	Mars	Venus	Mercury
1	The sun enters the zodiacal sign Aries	4	26	11	18	0 0 9	10 26 30	5 20 2	10 26 33	11 4 52	11 4 52	0 3 2

III.2 Almanac of 1824 CE

Text:[94]

|نوروز سلطاني ، اول موسم بهار | يكشنبه | ٢٠ | ٩ |قوي | سعد |

Translation:[95]

| *nevrūz-i sulṭānī*, first [day] of the season of spring | Sunday | 20 [Rajab]| 9 [March (jul.)] | fortunate |

92 Text established by the author, based on MS Florence, Biblioteca Medicea Laurenziana, Or. 27.

93 Translation by the author.

94 Text established by the author, based on MS Berlin, Staatsbibliothek, or. quart 1697; facsimile and German translation in M. Kurz, *Ein osmanischer Almanach für das Jahr 1239/1240 (1824/1825)* (Islamkundliche Untersuchungen 276; Berlin: Klaus Schwarz, 2007), p. 147 (facsimie) and p. 89 (translation).

95 Translation by the author.

References

R. Abdullāhī, *Tārīkh-i tārīkh dar Īrān* (Tehran: Intishārāt-i Amīr Kabīr, 1987).

A.T. Adamova and M. Bayani, *Persian Painting: The Arts of the Book and Portraiture* (London: Thames & Hudson, 2015).

S. H. Barani, 'The Jalali calendar (tarikh-i-Jalali or Maliki)', *Islamic Culture* 17 (1943), pp. 166–175.

A.D. Beihammer, *Byzantium and the Emergence of Muslim-Turkish Anatolia, ca. 1040-1130* (Birmingham Byzantine and Ottoman studies 20; London: Routledge, 2017).

S. Blair, *The Monumental Inscriptions from Early Islamic Iran and Transoxiana, Studies in Islamic Art and Architecture* (Supplements to Muqarnas 5; Leiden: Brill, 1992).

F.C. de Blois, *Persian Literature: A Bio-bibliographical Survey: Volume V, Part 2: Poetry ca. A.D. 1100 to 1225* (Leiden: Brill, 1994).

F.C. de Blois, 'The Persian Calendar', *Iran* 34 (1996), pp. 39–54.

F.C. Blois, 'The Zoroastrian Calendar: New Evidence from Achaemenid Bactria', in : N. Sims-Williams and F.C. de Blois (eds), *Studies in the Chronology of the Bactrian Documents from Northern Afghanistan* (Wien: Verlag der Österreichischen Akademie der Wissenschaften, 2018), pp. 109–12.

F.C. de Blois, 'Taʾrīkh: I. Dates and Eras in the Islamic World: 1. In the sense of "date, dating", etc.', in: P.J. Bearman et al. *Encyclopaedia of Islam: New Edition*, vol. X (Leiden: Brill, 2000), pp. 258–64.

P. Casanova, 'Le montre du sultan Noûr ad Dîn', *Syria* 4 (1923), pp. 282–99.

A. Caiozzo, 'The Horoscope of Iskandar Sultān as a Cosmological Vision in the Islamic World', in G. Oestmann, H.D. Rutkin, and K. von Stuckrad (eds), *Horoscopes and Public Spheres: Essays on the History of Astrology* (Berlin: Walter de Gruyter, 2005), pp. 115–44.

M.S. Champion, *The Fullness of Time: Temporalities of the Fifteenth-Century Low Countries* (Chicago: The University of Chicago Press, 2017).

E. Combe, J. Sauvaget, and G. Wiet (eds), *Répertoire chronologique d'épigraphie arabe (RCEA)* (Cairo: Imprimerie de l'IFAO, 1931–)

S. Cristoforetti, *Il natale della luce in Iran: Une festa delfuoco nel cuore di ogni inverno: Ricerche sul* sada*: occorrenze rituale e temi mitologici di una celebrazione cortese tra Baghdad e Bukhara, secc. IX–XII* (Milano: Associazione Culturale Mimesis, 2002).

B. van Dalen, E.S. Kennedy, and M.K. Saiyid, 'The Chinese-Uyghur Calendar in Ṭūsī's Zīj-i Īlkhānī', *Zeitschrift für Geschichte der arabisch-islamischen Wissenschaften* 11 (1997), pp. 111–51.

B. van Dalen, 'The Malikī Calendar in the *Dustūr al-munajjimīn*', in E. Orthmann and P. Schmidl (eds), *Science in the City of Fortune: The* Dustūr al-Munajjimīn *and its World* (Bonner Islamstudien 39; Berlin: EB-Verlag, 2017), pp. 117–35.

M. Dirāyatī, *Fihristgān: nuskha-hā-yi khaṭṭī-i Īrān (Fankhā)*, Nuskhah'shināsī 1 (Tehran: Sāzmān-i Asnād wa Kitābkhāna-i Millī-i Jumhūrī-i Islāmī-i Īrān, 2011).

G. Dohrn-Van Rossum, *History of the Hour: Clocks and Modern Temporal Orders* (Chicago: University of Chicago Press, 1996).

L.P. Elwell-Sutton, 'A Royal Timūrid Nativity Book', in R.M. Savory and D.A. Agius (eds), *Logos Islamikos: Studia Islamica in honorem Georgii Michaelis Wickens* (Toronto: Pontifical Institute of Mediaeval Studies, 1984), pp. 119–36.

S. Fang, *Zhongguo shi liri he Zhong xi liri duizhao biao* [中国史歷日和中西歷日對照表] (Shanghai: Shanghai cishu chubanshe, 1987).

H.R. Giahi Yazdi, 'The *Jalālī* Celendar: The Enigma of its Radix Date', *Archive for History of Exact Sciences* 74 (2020), pp. 165–82.

F.K. Ginzel, *Handbuch der mathematischen und technischen Chronologie: Das Zeitrechnungswesen der Völker* (Leipzig: J.C. Hinrichs, 1906–1914).

B.R. Goldstein and D. Pingree, 'Astrological Almanacs from the Cairo Geniza', *Journal of Near Eastern Studies* 38 (1979), pp. 153–75 and 231–56.

B.R. Goldstein and D. Pingree, 'Additional Astrological Almanacs from the Cairo Geniza', *Journal of the American Oriental Society* 103 (1983), pp. 673-90.

M. Gronke, *Arabische und persische Privaturkunden des 12. und 13. Jahrhunderts aus Ardabil (Aserbaidschan)* (Islamkundliche Untersuchungen 72; Berlin: Klaus Schwarz, 1982).

M. Gronke, 'The Arabic Yārkand Documents', *Bulletin of the School of Oriental and African Studies* 49 (1986), pp. 454–507.

M. Gronke, *Derwische im Vorhof der Macht: Sozial- und Wirtschaftsgeschichte Nordwestirans im 13. und 14. Jahrhundert* (Freiburger Islamstudien 15; Stuttgart: Steiner, 1993).

Ḥajjī Khalīfa, *Kash al-ẓunūn ʿan asāmī l-kutub wa-l-funūn = Keşf-el-zunun* (ed. Ş. Yaltkaya and R. Bilge; İstanbul: Milli Eğitim Basımevi, 1971).

G. Herrmann, *Persische Urkunden der Mongolenzeit: Text- und Bildteil* (Documenta Iranica et Islamica 2; Wiesbaden: Harrassowitz, 2004).

G. Herrmann, 'Urkundenfunde in Āẕerbāyğān', *Archäologische Mitteilungn aus Iran* N.F. 4 (1971), pp. 249–62.

Ibn al-Athīr, ʿAlī ibn Muḥammad, *al-Kāmil fī l-taʾrīkh* (ed. Abū l-Fidāʾ ʿAbdallāh al-Qāḍī; Beirut: Dār al-kutub al-ʿilmiyya, 1987–2003).

L. Kalus, *Thesaurus d'Épigraphie Islamique* (http://www.epigraphie-islamique.org, assessed 19 August 2020).

L. Kalus and C. Guillot, 'Réinterprétation des plus anciennes stèles funéraires islamiques nousantariennes: III. Sri Lanka', *Archipel* 72 (2006), pp. 15–68.

E.S. Kennedy, 'The Chinese-Uyghur Calendar as Described in the Islamic Sources', *Isis* 55 (1964), pp. 435–43.

F. Keshavarz, 'The Horoscope of Iskandar Sultan', *Journal of the Royal Asiatic Society* 116 (1984), pp. 197–208.

F. Keshavarz, *A Descriptive and Analytical Catalogue of Persian Manuscripts in the Library of the Wellcome Institute for the History of Medicine* (London: Wellcome Institute for the History of Medicine, 1986).

Ch. Kiening, 'Mediating the Passion in Time and Space', in C. Kiening and M. Stercken (eds), *Temporality and Mediality in Late Medieval and Early Modern Culture* (Turnhout: Brepols, 2018), pp. 115–46.

D.A. King, *In Synchrony with the Heavens: Studies in Astronomical Timekeeping and Instrumentation in Medieval Islamic Civilization* (Islamic Philosophy, Theology and Science 55; Leiden: Brill, 2004-2005).

M. Kurz, *Ein osmanischer Almanach für das Jahr 1239/1240 (1824/1825)* (Islamkundliche Untersuchungen 276; Berlin: Klaus Schwarz, 2007).

J. Le Goff, 'Au Moyen Age: Temps de l'Eglise et temps du marchand', *Annales. Histoire, Sciences Sociales* 15 (1960), pp. 413–33.

J. Le Goff, 'Merchant's time and church's time', in idem, *Time, Work and Culture in the Middle Ages* (Chicago: University of Chicago Press, 1989), pp. 29–42.

J.G. Leichter, *The Zīj as-Sanjarī of Gregory Chioniades: Text, Translation and Greek to Arabic Glossary* (Ph.D. thesis, Brown University, 2004).

Ch. Melville, 'The Chinese-Uyghur Animal Calendar in Persian Historiography of the Mongol Period', *Iran* 32 (1994), pp. 83–98.

J.W. Meri (ed.), *Medieval Islamic Civilization: An Encyclopedia* (London: Routledge, 2005).

REQUEST FOR AUTHOR: PLEASE ADD FULL REFERENCE: Minorsky, 'Documents I',

V. F. Minorsky, 'Some early documents in Persian I', *Journal of the Royal Asiatic Society* (1942), pp. 181–194.

W.H. Morley, *Description of a Planispheric Astrolabe Constructed for Sháh Sultán Husain Safawí, King of Persia, and Now Preserved in the British Museum; Comprising an Account of the Astrolabe Generally, with Nores Illustrative and Explanatory: To which are Added, Concise Notices of Twelve Other Astrolabes, Eastern and European, Hitherto Undescribed* (London: Williams and Norgate, 1856).

S.M. Mozaffari, 'The Effect of Astrological Opinions on Society: A Preliminary View', *Trames* 16 (2012), pp. 359–68.

Nabaʾī, Abū l-Faḍl, *Gāhshumārī dar tārīkh*, Sāzmān-i Muṭālaʿa wa Tadwīn-i Kutub-i ʿUlūm-i Insānī-i Dānishgāhhā; 565.Tārīḫ 16 (Tehran: Sāzmān-i Muṭālaʿa wa Tadwīn-i Kutub-i ʿUlūm-i Insānī-i Dānishgāhhā [SAMT], 2002).

Nāṣir Ḫusrau, *Book of travels = Safarnāmah: a parallel Persian-English text* (ed. and transl. W.M. Thackston; Bibliotheca Iranica. Intellectual traditions series 6; Costa Mesa, Calif.: Mazda Publishers, 2001).

D.S. Richards, 'Written documents', in W. Kubiak and G.T. Scanlon (eds), *Fusṭāt excavation final report II* (American Research Center in Egypt Reports 2; Wiona Lake: Eisenbrauns, 1989), pp. 4–80.

B.A. Rozenfeld and A.P. Juškevič, *Omar Chajjam* (Moscow: Izd. Nauka, 1965).

F. Sarre and E. Herzfeld, *Archäologische Reise im Euphrat- und Tigris-Gebiet III* (Forschungen zur islamischen Kunst 1; Berlin: Reimer, 1911).

E. Savage-Smith, *Islamicate Celestial Globes. Their History, Construction, and Use* (Smithsonian Studies in History and Technology 46; Washington, D.C.: Smithsonian Institution Press, 1985).

A. Sayılı, *The Observatory in Islam and its Place in the General History of the Observatory* (Ankara: Türk Tarih Kurumu Basımevi, 2nd ed., 1988).

G.T. Scanlon, 'Fustat', in E.M. Meyers (ed.), *The Oxford Encyclopedia of Archaeology in the Near East* (New York: Oxford University Press, 1997), pp. 365– 68.

L.P.E. Sédillot, *Prolégomènes des tables astronomiques d'Oloug-Beg, publiés avec notes et variantes et précédés d'une introduction* (Peris: Firmin Didot, 1847).

A.T. Şen, *Astrology in the Service of the Empire: Knowledge, Prognostication, and Politics at the Ottoman Court 1450s–1550s* (Ph.D. thesis, University of Chicago, 2016).

B. Spuler, *Wüstenfeld-Mahler'sche Vergleichungs-Tabellen zur muslimischen und iranischen Zeitrechnung: mit Tafeln zur Umrechnung orient-christlicher Ären* (Wiesbaden: Steiner, 1961)

S. Stern, *Calendars in Antiquity: Empires, States, and Societies* (Oxford: Oxford University Press, 2012).

J. Thomann, 'The Arabic Ephemeris for the Year 1149/1150 CE (P.Cambridge UL Inv. Michael. Chartae D 58) and the Arabic Baḫnīṭas, Greek Παχνίτης and Coptic ⲡⲁϣⲟⲛⲥ', *Chronique d'Égypte* 90.179 (2015), pp. 207–24.

J. Thomann, 'Ephemeride für das persische Jahr 413 (1044/1045 n. Chr.)', in A. Zdiarsky (ed.), *Orakelsprüche, Magie und Horoskope: wie Ägypten in die Zukunft sah* (Nilus 22; Wien: Phoibos-Verlag, 2015), pp. 138–40.

J. Thomann, 'Almanach für das koptische Jahr 707 (990/991 n. Chr.)', in A. Zdiarsky (ed.), *Orakelsprüche, Magie und Horoskope: wie Ägypten in die Zukunft sah* (Nilus 22; Wien: Phoibos-Verlag, 2015), pp. 140-41.

J. Thomann, 'A Fragment of an Unusual Arabic Almanac for 297 AH/910 CE (P.Berl. inv. 12793)', in S. Souderbala, S. Denoix, and M. Malczycki (eds), *New frontiers of Arabic papyrology: Arabic and Multilingual Texts from Early Islam* (Leiden: Brill, 2017), pp. 179-96.

J. Thomann, 'From Katarchai to Ikhtiyārāt: The Emergence of a New Arabic Document Type Combining Ephemerides and Amanacs', in A. Nodar and S. Torallas Tovar (eds), *Proceedings of the 28th Congress of Papyrology Barcelona 1–6 August 2016 (*Barcelona: Publicacions de l'Abadia de Montserrat, 2019), pp. 342-54.

J. Thomann, 'Tools of Time: Devices for Organizing Public and Private Life in the Premodern Islamic World', in A. Pellitteri et al. (eds), *Re-defining a Space of Encounter. Islam and Mediterranean: Identity, Alterity and Interactions: Proceedings of the 28th Congress of the Union Européenne des Arabisants et Islamisants* (Leuven: Peeters, 2019), pp. 97–105.

J. Thomann, 'Ritual Time, Civil Time, and Cosmic Time: Three Co-Existing Temporalities in Premodern Islamic Society', *Kronoscope* 20 (2020), pp. 41–63.

N.M. Tourkin, 'Astrological Images in Two Persian Manuscripts' in N. Allan (ed.), *Pearls of the Orient: Asian treasures of the Wellcome Library* (Chicago: Serindia, 2003), pp. 105–9.

S. Tourkin, 'L'Oroscopo di Shāh Tahmāsp', in S.R. Canby and J. Thompson (eds), *A caccia in Paradiso: Arte di corte nella Persia del Cinquecento* (Milano: Skira, 2005), pp. 327–31.

S. Tourkin, 'The Horoscope for Shah Tahmāsp', in S.R. Canby and J. Thompson (eds), *Hunt for Paradise: Court Arts of Safavid Iran 1501–1576* (Milan: Skira, 2003)

Uluğ Beg, *Zidž: Novye Guraganovy astronomičeskie tablicy* (transl. A.A. Achmedov Taškent; Fan, 1994).

Uluğ Beg, *Uluğ Beg'in astronomi cetvelleri: Zîc-i Uluğ Beg* (Bilimin ve felsefenin doğulu öncüleri dizisi 13; Istanbul: Kültür ve Turizm Bakanlığı, 2012).

[ps.–]ʿUmar Khayyām, *Nawrūznāma* (ed. by Mojtaba Minovi; Tehran: Kaveh, 1933).

S. Vryonis, *The Decline of Medieval Hellenism in Asia Minor and the Process of islamization from the Eleventh through the Fifteenth Century* (Publications of the Center for Middle Eastern Studies 4; Berkeley: California University Press, 1971).